Politecnico di Torino

Porto Institutional Repository

[Proceeding] Refined Shell Elements for the Analysis of Multifield Problems in Multilayered Structures

(Article begins on next page)

11th World Congress on Computational Mechanics (WCCM XI)
5th European Conference on Computational Mechanics (ECCM V)
6th European Conference on Computational Fluid Dynamics (ECFD VI)
July 20–25, 2014, Barcelona, Spain

REFINED SHELL ELEMENTS FOR THE ANALYSIS OF MULTIFIELD PROBLEMS IN MULTILAYERED STRUCTURES

Maria Cinefra[1], Stefano Valvano[1] and Erasmo Carrera[1]

[1] Department of Mechanical and Aerospace Engineering, Politecnico di Torino
Corso Duca degli Abruzzi 24, 10129, Torino, Italy
maria.cinefra, stefano.valvano, erasmo.carrera {@*polito.it*} www.mul2.com

Key words: *Refined shell elements, multifield problems, multilayered structures.*

The present work deals with the analysis of multilayered plates and shells under mechanical, thermal and electrical loads. Finite elements based on the Carrera Unified Formulation (CUF) with layer-wise capabilities are employed to ensure an accurate description of the mechanical, thermal and electrical fields in the layers. The governing equations are derived from the Principle of Virtual Displacement (PVD). To overcome, in some cases, the discontinuity of the derived variables at the layers interfaces, the governing equations are obtained using the Reissner's Mixed Varational Theorem (RMVT) extended to the electro-mechanical cases. The Mixed Interpolated Tensorial Components (MITC) method is employed to contrast the membrane and shear locking phenomenon that usually affects shell finite elements [1]. Plate finite elements based on CUF for the analysis of thermo-mechanical and electro-mechanical problems have been already presented in [2] and [3], respectively. One of the most interesting features of the unified formulation consists in the possibility to keep the order of the expansion of the state variables along the thickness of the shell as a parameter of the model. Moreover, both equivalent single layer (ESL) and layer-wise (LW) descriptions of the variables are allowed. Some results from the static and dynamic analysis of plates and shells under multifield loads will be provided, in order to show the efficiency of the models presented.

REFERENCES

[1] M. Cinefra and E. Carrera., "Shell finite elements with different though-the-thickness kinematics for the linear analysis of cylindrical multilayered structures," *International Journal for Numerical Methods in Engineering*, 93, 160 182, (2013).

[2] A. Robaldo, E. Carrera and A. Benjeddou, "Unified Formulation for finite element thermoelastic analysis of multilayered anisotropic composite plates," *Journal of Thermal Stresses*, 28, 1031-1064, (2005).

[3] E. Carrera, S. Brischetto, M. Cinefra "Variable kinematics and advanced variational statements for free vibrations analysis of piezoelectric plates and shells.," *Computer Modeling in Engineering & Sciences*, 65(3), 259-341, (2010).